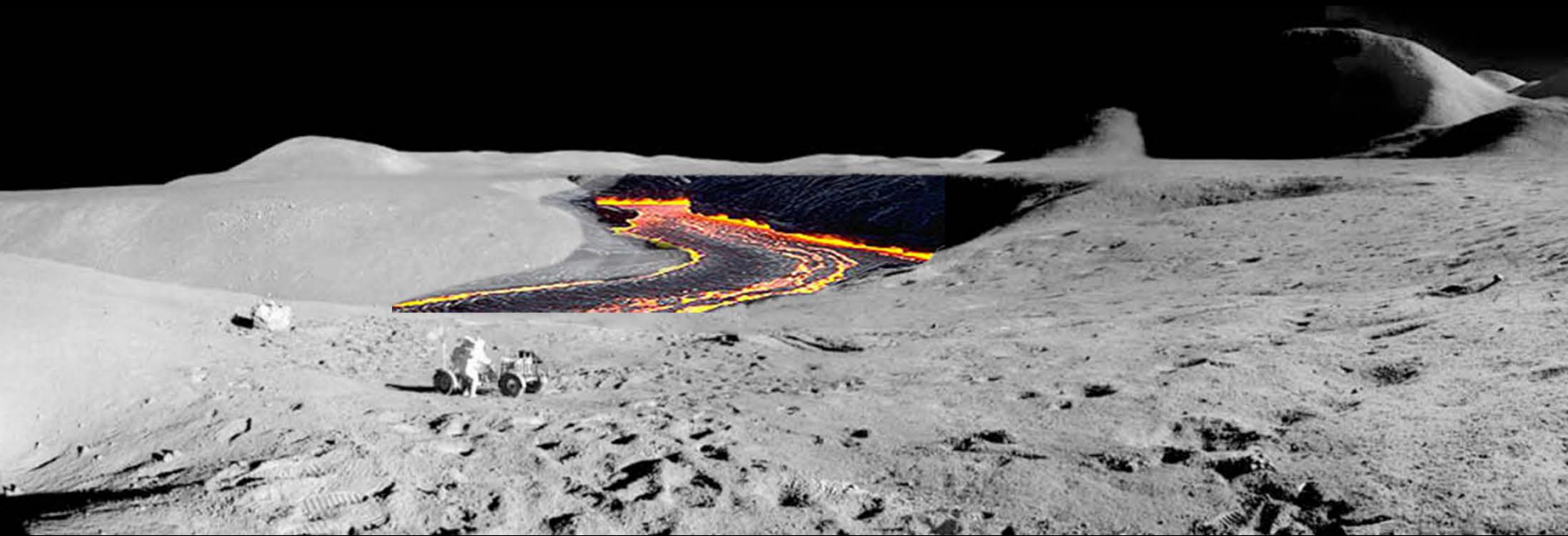


LAVA ERUPTION AND EMPLACEMENT: USING CLUES FROM HAWAII AND ICELAND TO PROBE THE LUNAR PAST



Station 2 Panorama, frames A15-85-11446 – 11455.

Debra Hurwitz Needham

NASA Marshall Space Flight Center

C.W. Hamilton, J.E. Bleacher, P.L. Whelley, K.E. Young,

S.P. Scheidt, J.A. Richardson, S.S. Sutton

TALK OVERVIEW

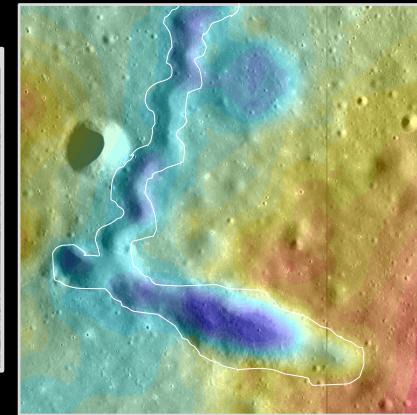
- Introduction to the Lunar Sinuous Rille Rima Bode.
 - Location and morphology.
- Origin of the Vent and Channel.
 - Clues from Holuhraun, Iceland's 2014/2015 eruption.
- Origin of the Channel and Lava Pond.
 - Clues from Kilauea, HI's December 1974 eruption.
- Lessons Learned for Rima Bode.



The 2014/15 Holuhraun eruption.
Daði Hardarson ©Nýjar viddir, with permission



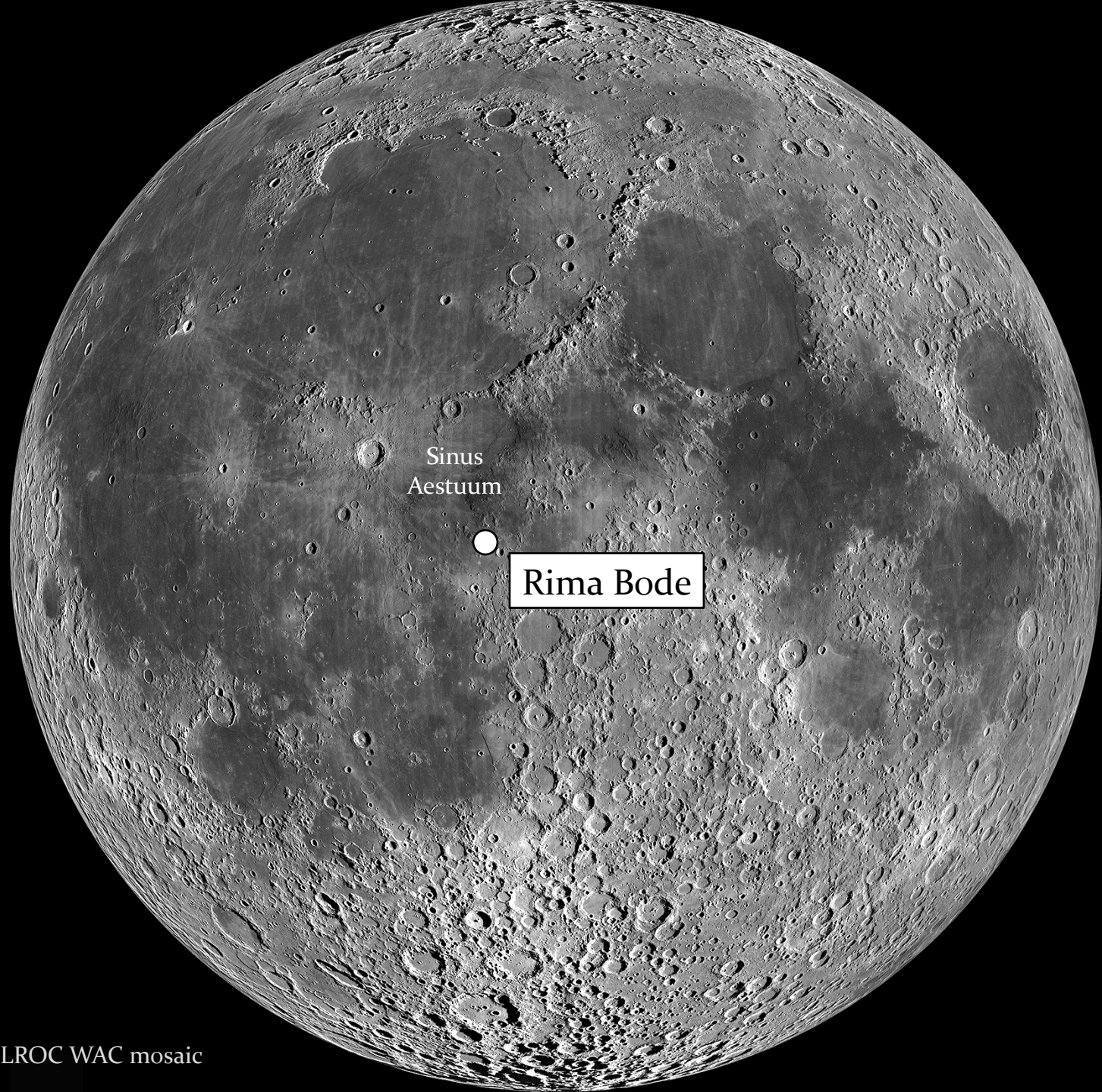
The Dec. 1974 Kilauea lava flow. *Photo by Needham.*



Rima Bode, Moon.
Kaguya TC image.

The image is a composite of four grayscale photographs of the Moon's surface, arranged in a 2x2 grid. The top-left and bottom-right panels show a dark, heavily cratered lunar surface with a prominent, dark, winding feature, possibly a crater rim or a shadowed depression. The top-right and bottom-left panels show a lighter, more reflective lunar surface with numerous smaller, more numerous craters. The central text is overlaid on the top-right and bottom-left panels.

Rima Bode, Moon



Sinus
Aestuum

Rima Bode

Rima Bode:

Channel Length

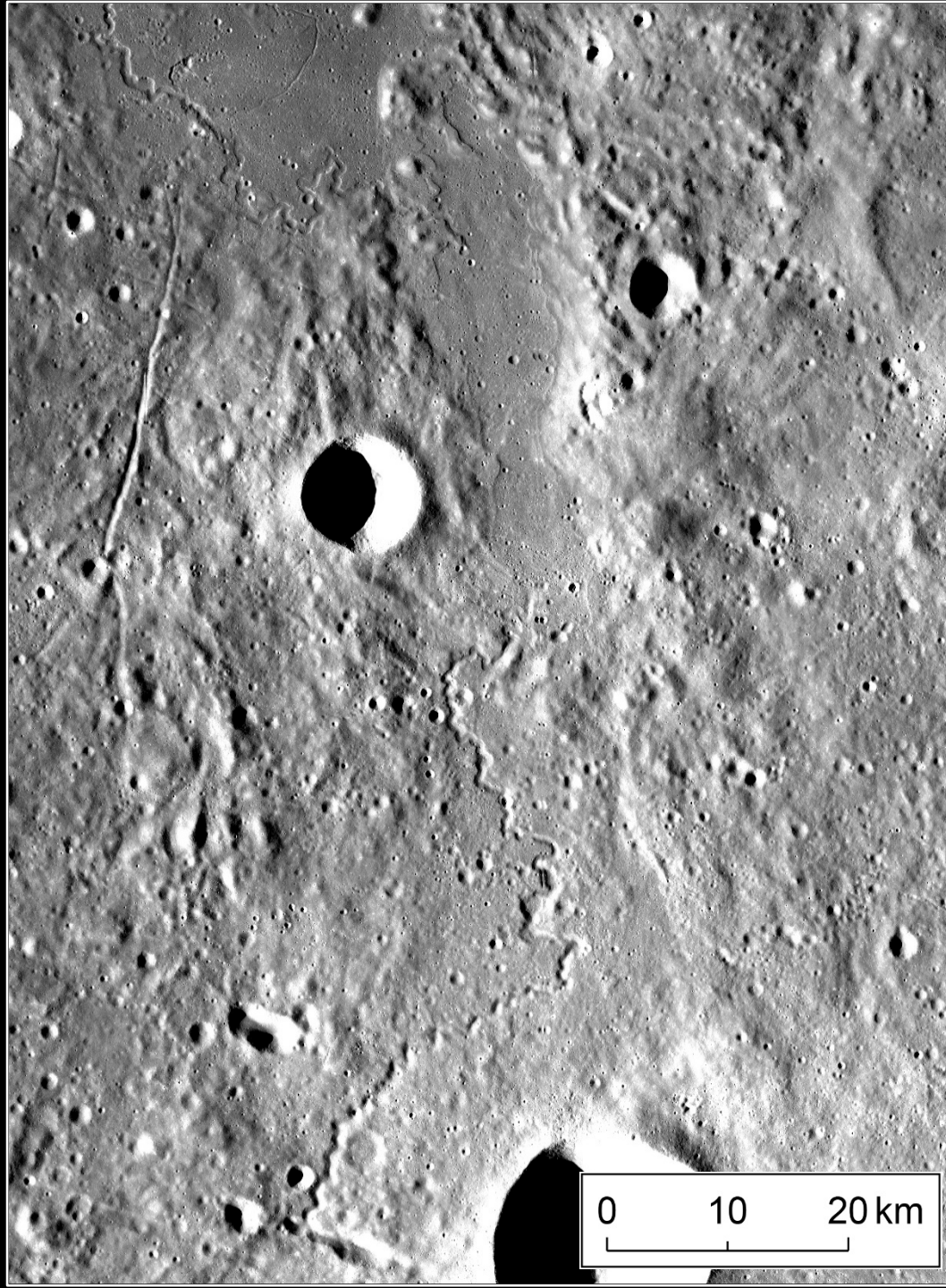
- 109 km (upper),
139 km (lower).

Channel Width

- 870 m (upper),
670 m (lower).

Channel Depth

- 100 m (upper),
75 m (lower).



Kaguya TC mosaic

Rima Bode:

Channel Length

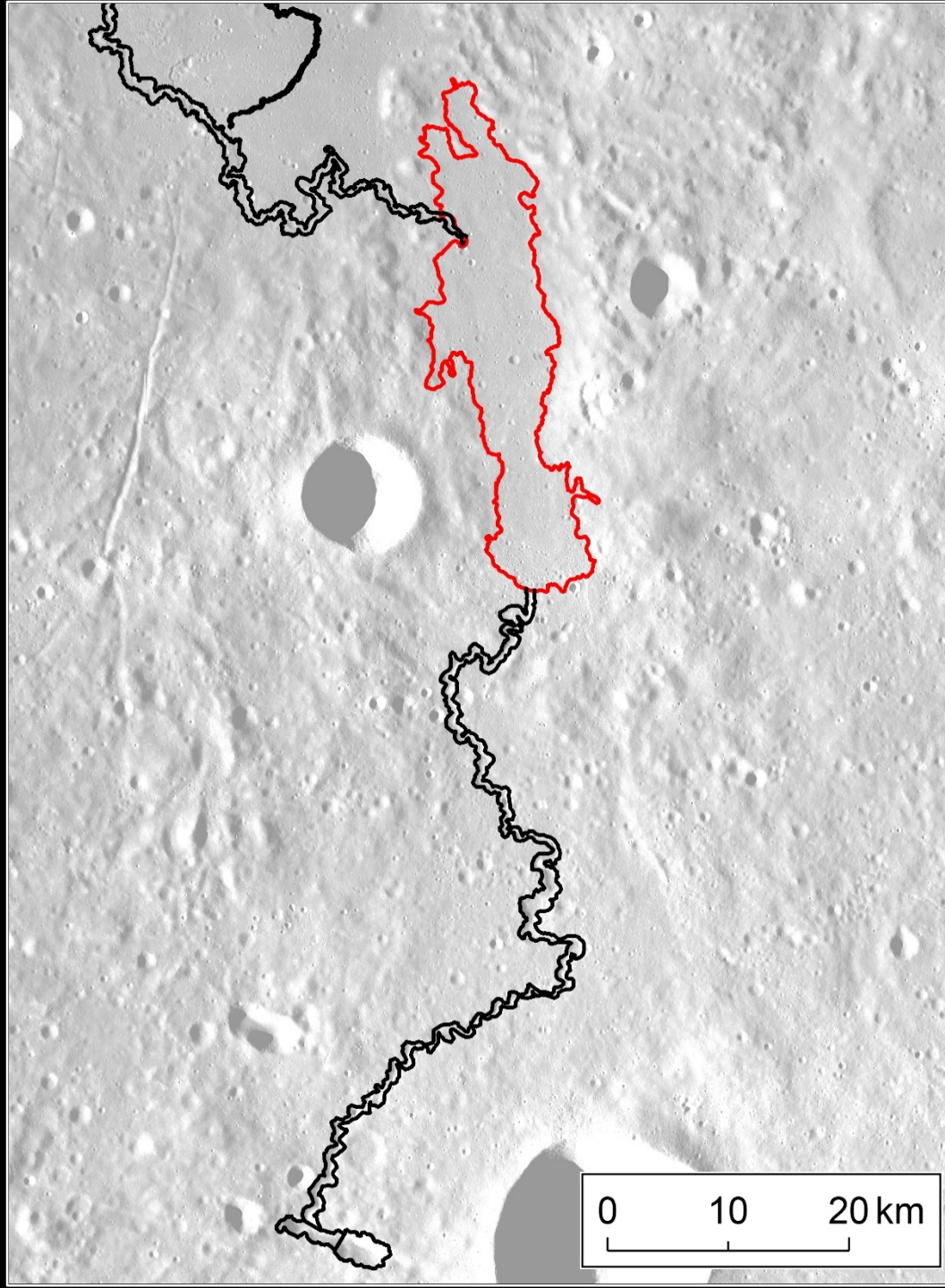
- 109 km (upper),
139 km (lower).

Channel Width

- 870 m (upper),
670 m (lower).

Channel Depth

- 100 m (upper),
75 m (lower).



Rima Bode:

Channel Length

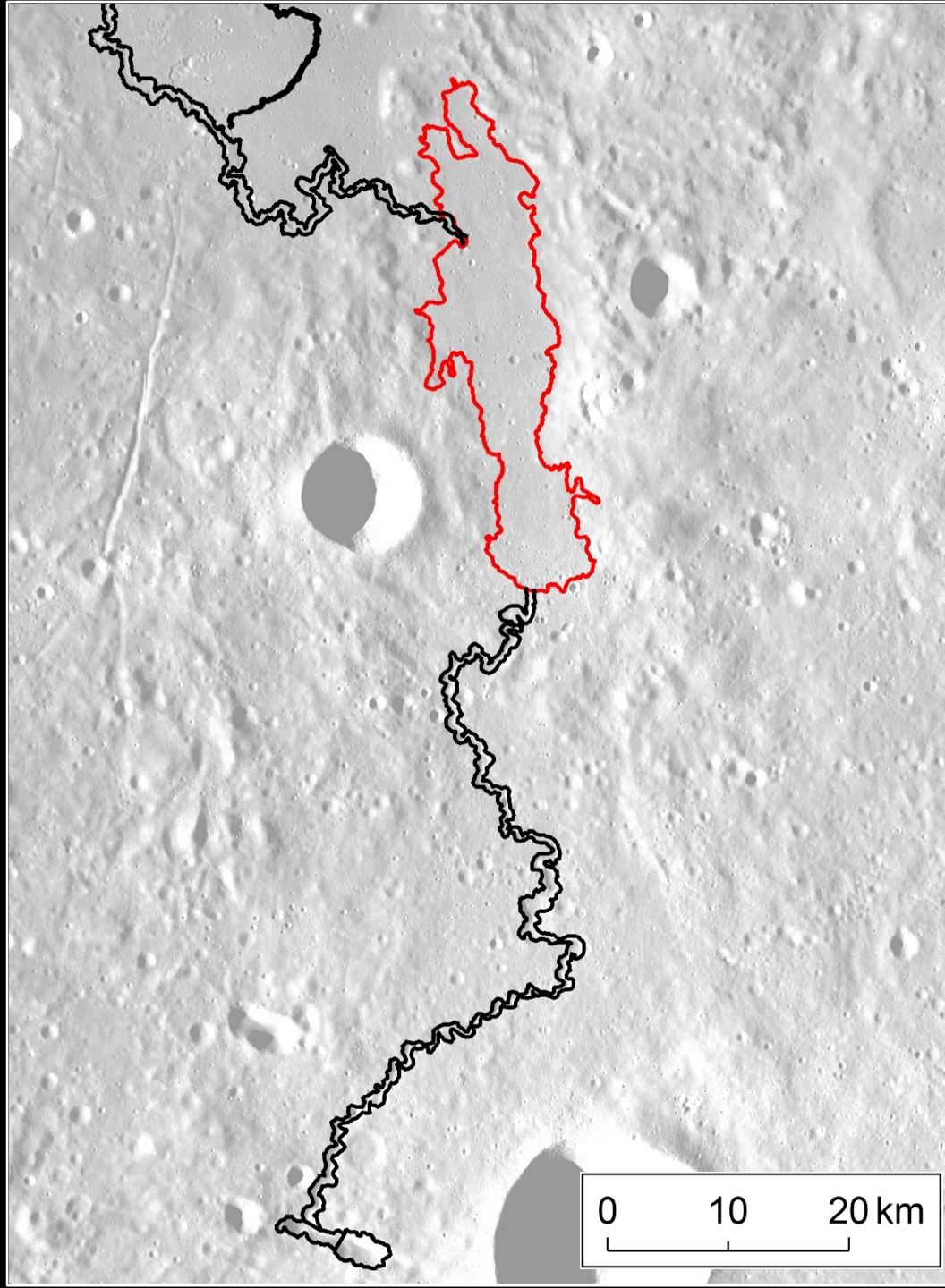
- 109 km (upper),
139 km (lower).

Channel Width

- 870 m (upper),
670 m (lower).

Channel Depth

- 100 m (upper),
75 m (lower).



How did the
channel develop?

What separates
the two channel
segments?

Rima Bode:

Vent Area

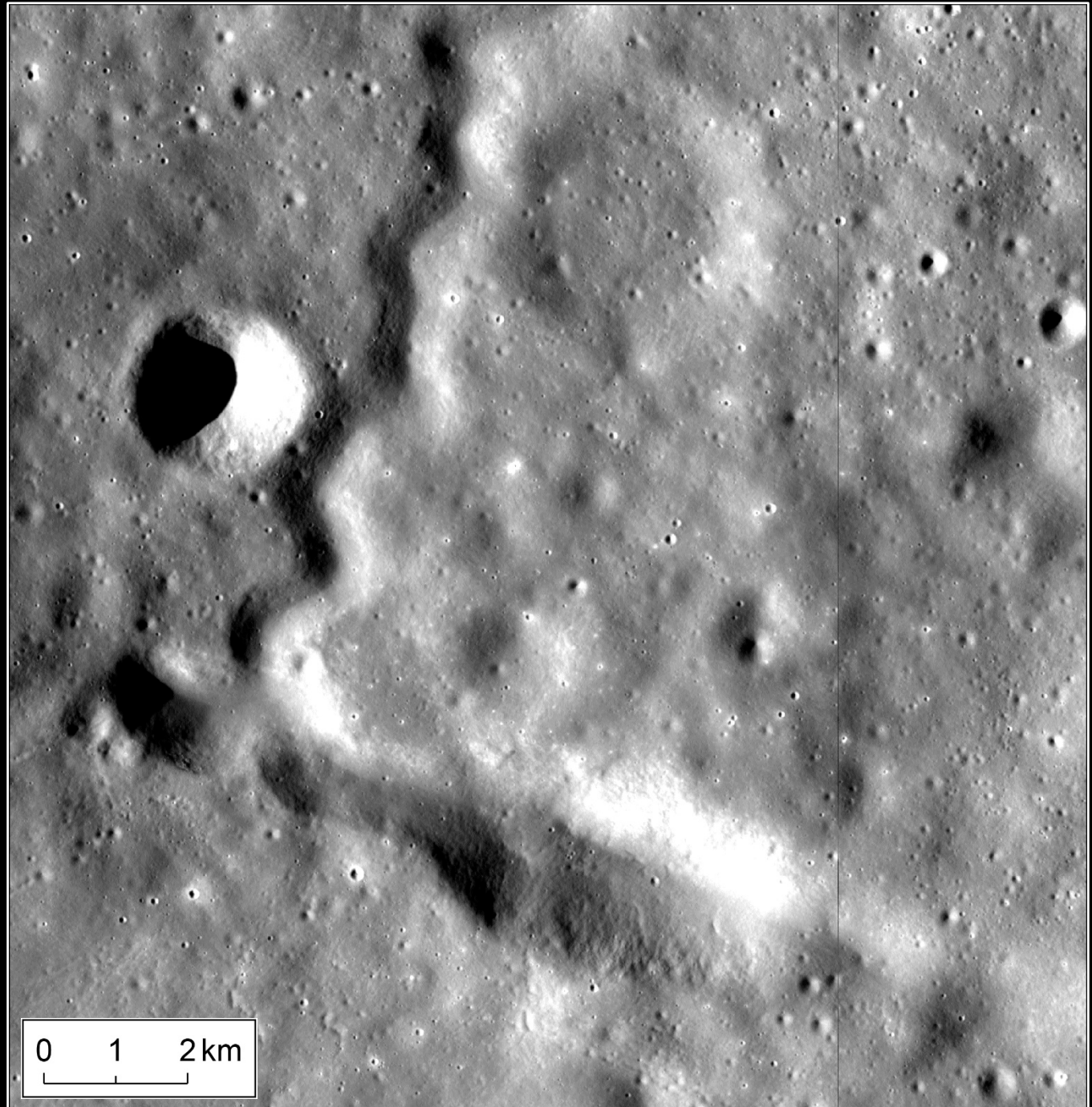
- 15 km².

Vent Depth

- 406 m (160–500 m).

Vent Volume

- 6 km³.



Rima Bode:

Vent Area

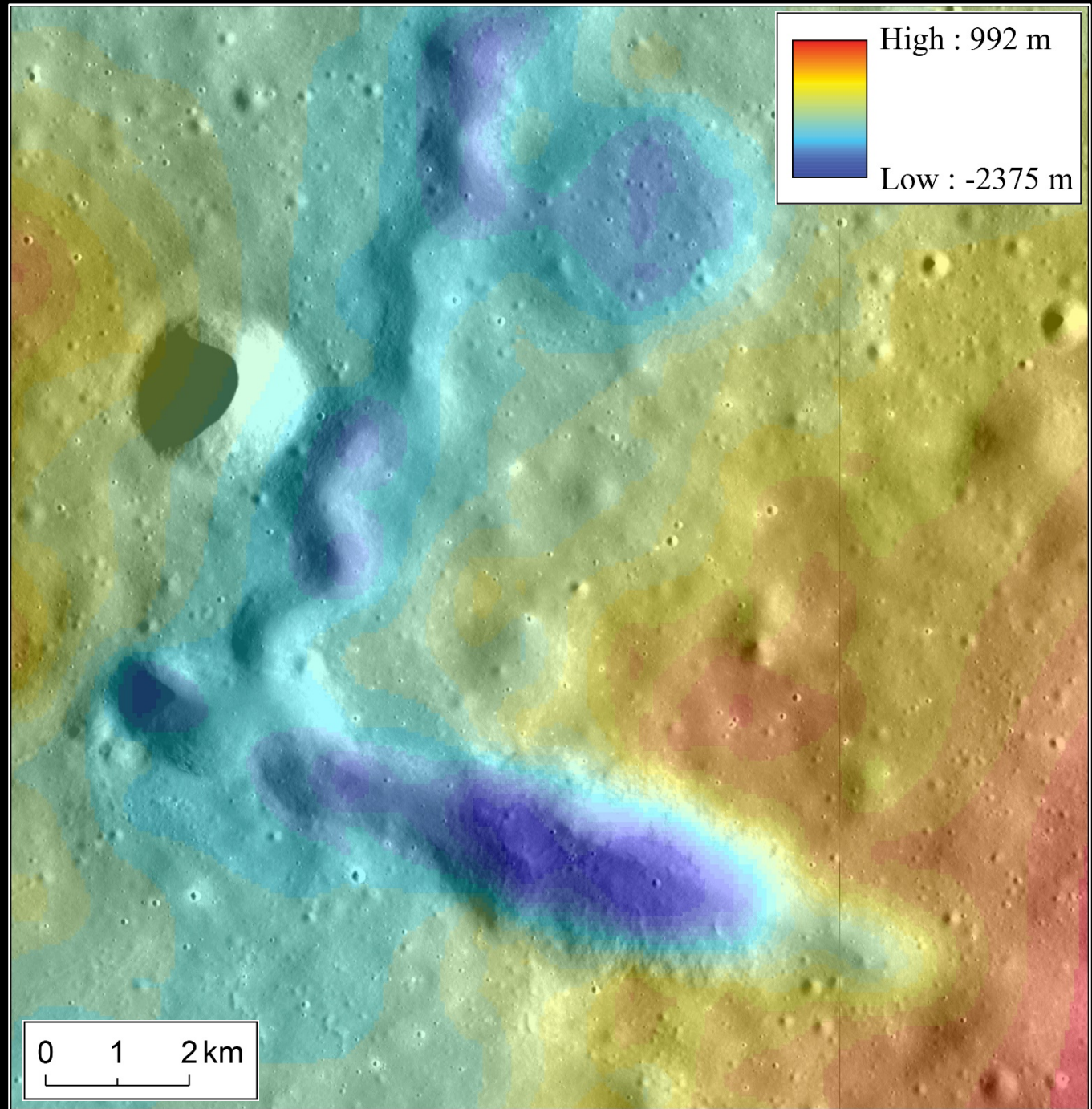
- 15 km².

Vent Depth

- 406 m (160–500 m).

Vent Volume

- 6 km³.



LOLA topography

Rima Bode:

Vent Area

- 15 km².

Vent Depth

- 406 m (160–500 m).

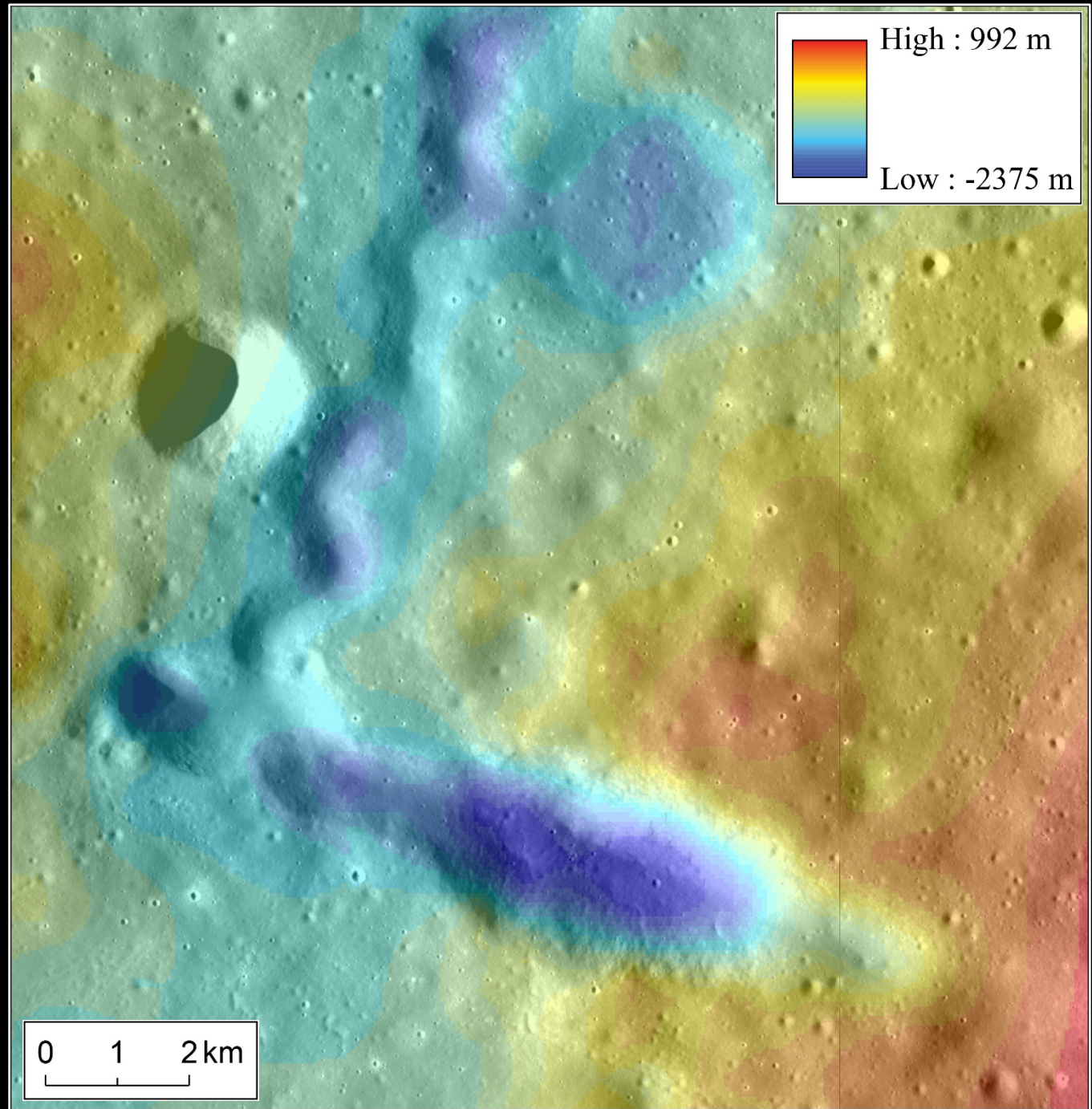
Vent Volume

- 6 km³.

What is the origin
of the circular vent
features?

How did the
channel develop?

Did lava pool in
the vent before
forming the
channel?



Rima Bode:

Feature Area

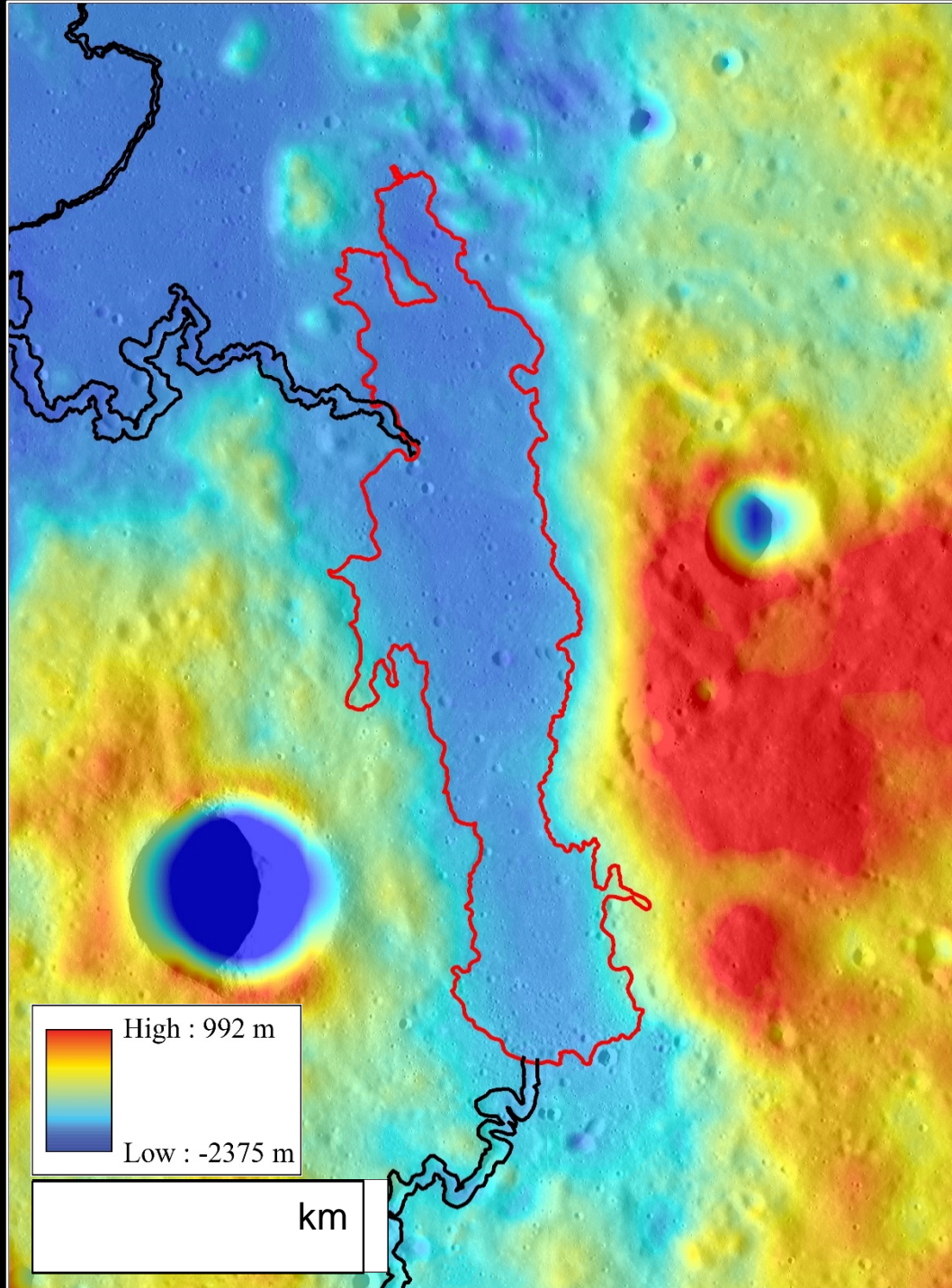
- 266 km².

Feature Depth

- ~60 – 80 m.

Feature Volume

- 14 km³.



LOLA topography

Rima Bode:

Feature Area

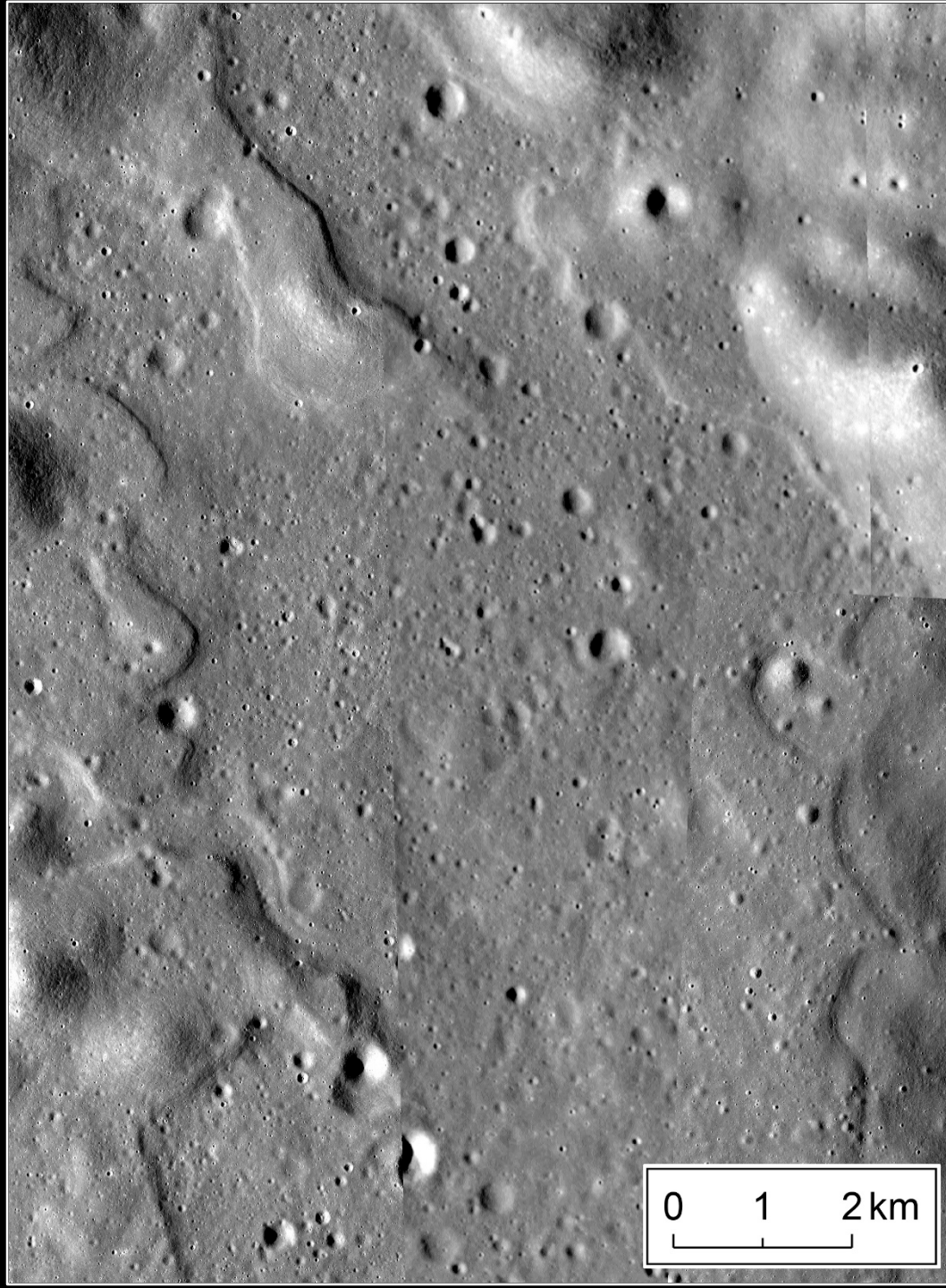
- 266 km².

Feature Depth

- ~60 – 80 m.

Feature Volume

- 14 km³.



LROC NAC images and
Kaguya TC mosaic

Rima Bode:

Feature Area

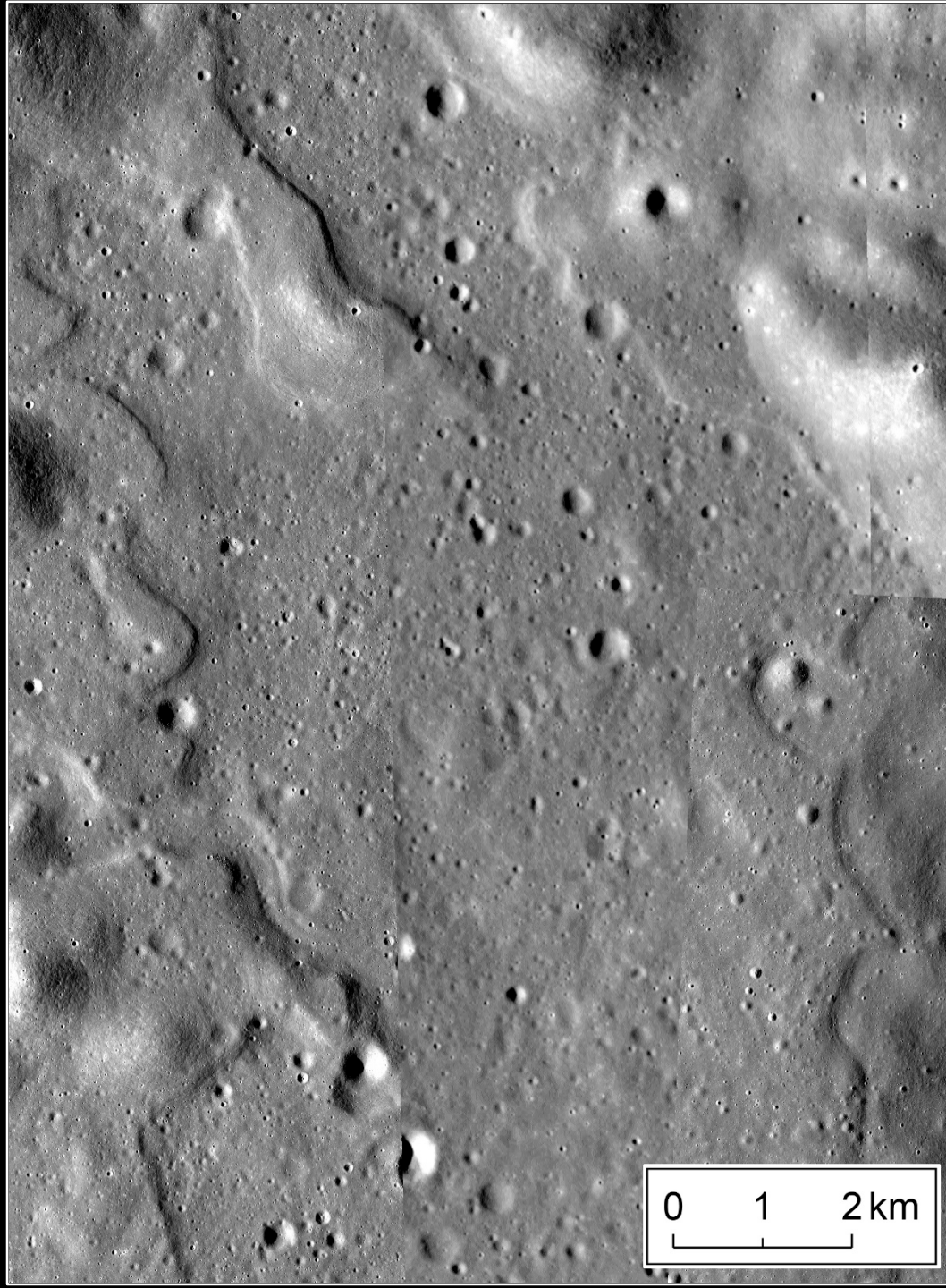
- 266 km².

Feature Depth

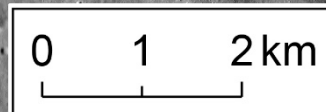
- ~60 – 80 m.

Feature Volume

- 14 km³.



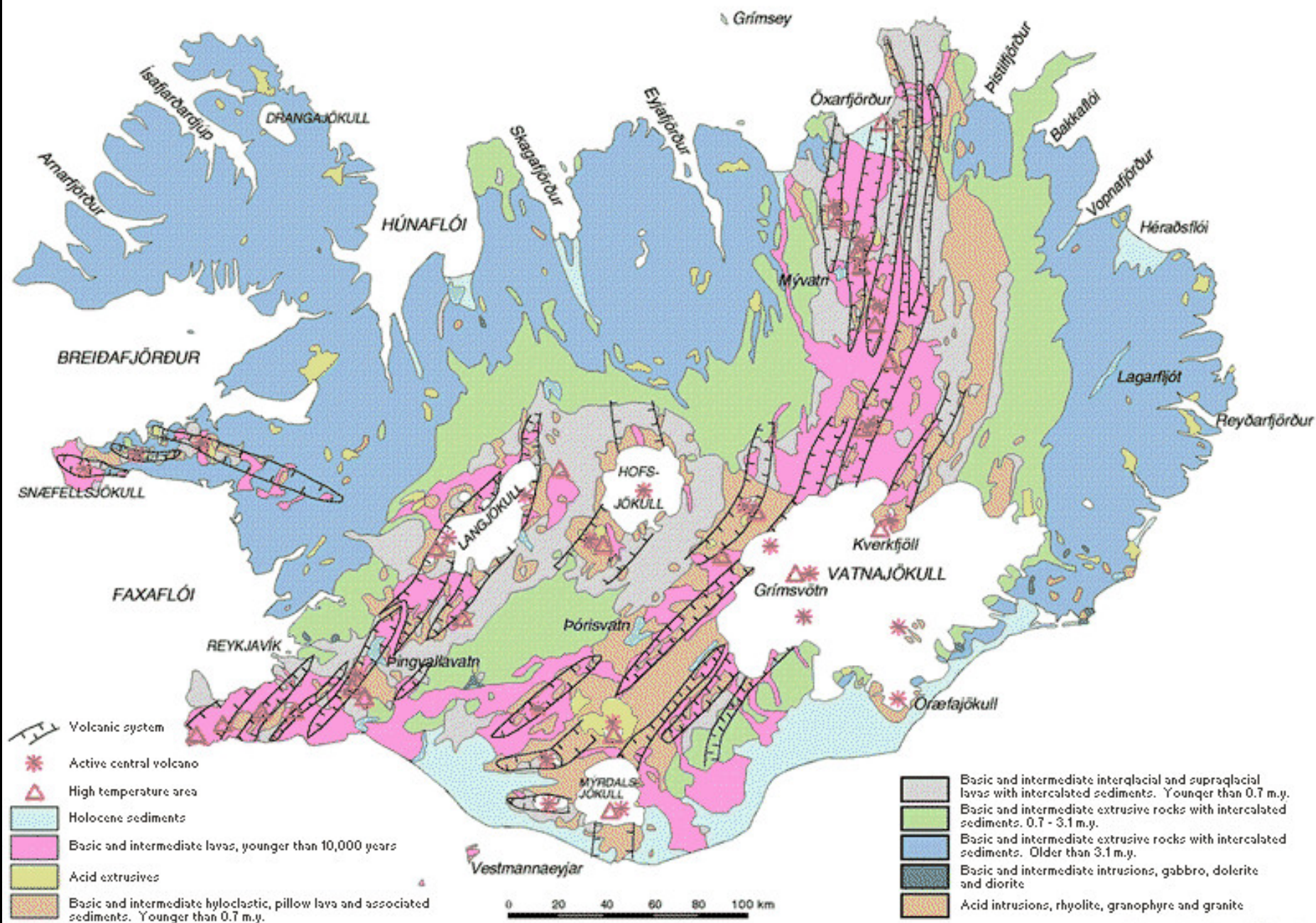
What is this
feature, and
how did it
form?

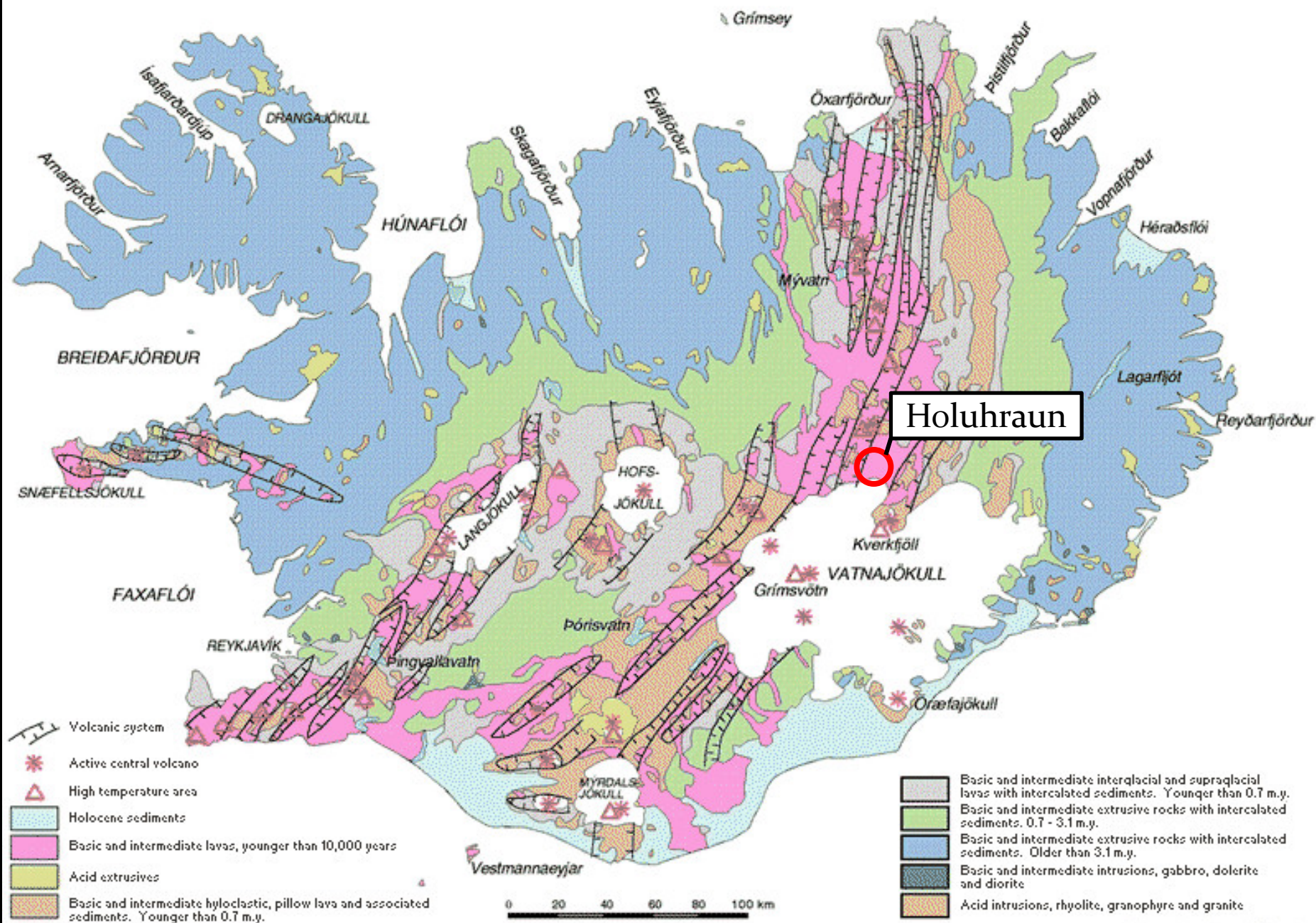


LROC NAC images and
Kaguya TC mosaic



2014-15 Holuhraun Eruption, Iceland





Holuhraun

<https://youtu.be/aAnuMD9TY14>

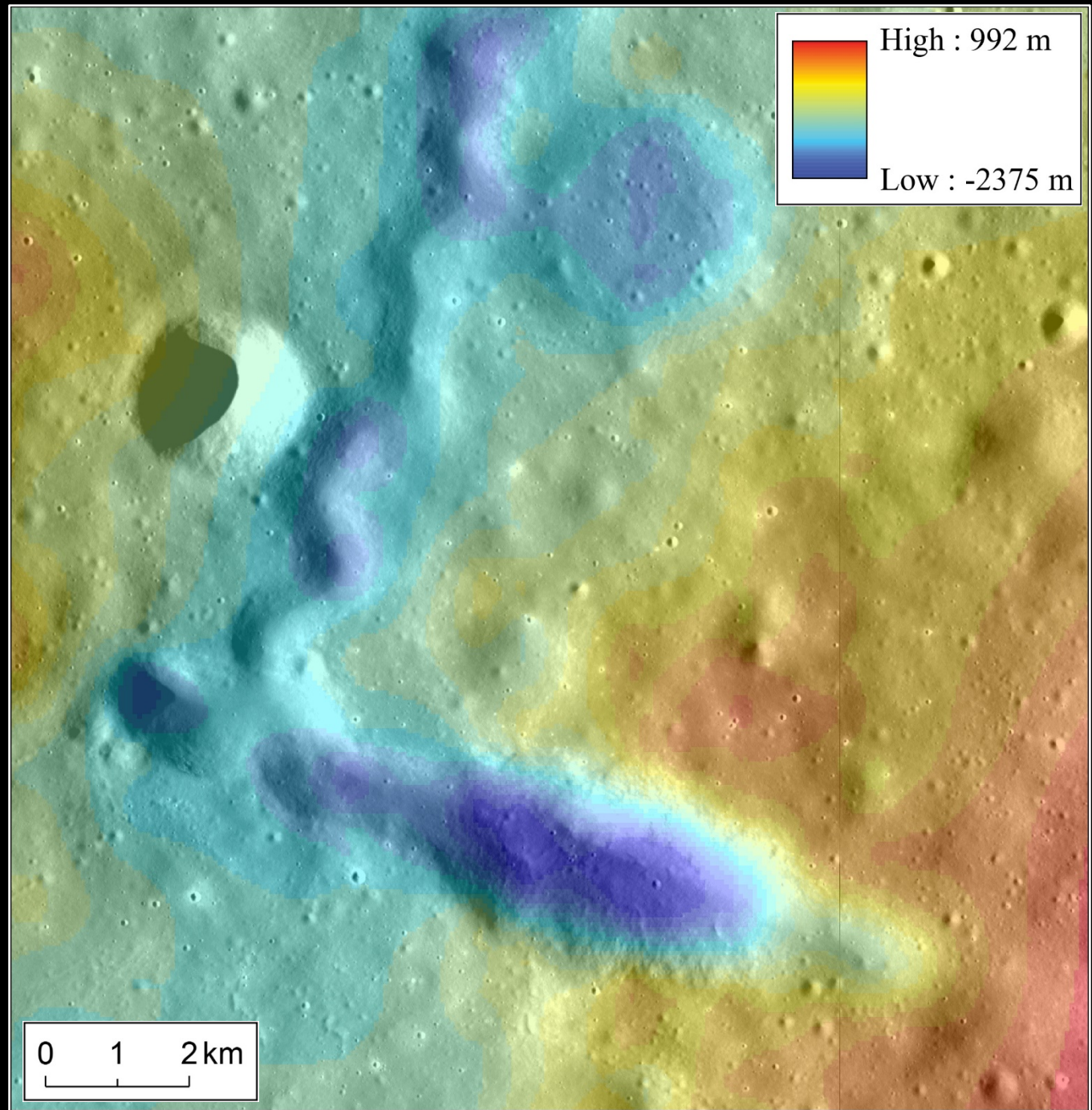
<https://www.youtube.com/watch?v=fmCJSS2YAP0>



What is the origin
of the circular vent
features?

How did the
channel develop?

Did lava pool in
the vent before
forming the
channel?




CONCLUSIONS 1: CHANNEL INITIATION

- Rare opportunity to compare active eruption with post-eruption flow morphology.
- Channel initiated early, as the vent developed around it.
- Minor amounts of mechanical erosion may occur locally.



Daði Harðarson ©Nýjar viddir





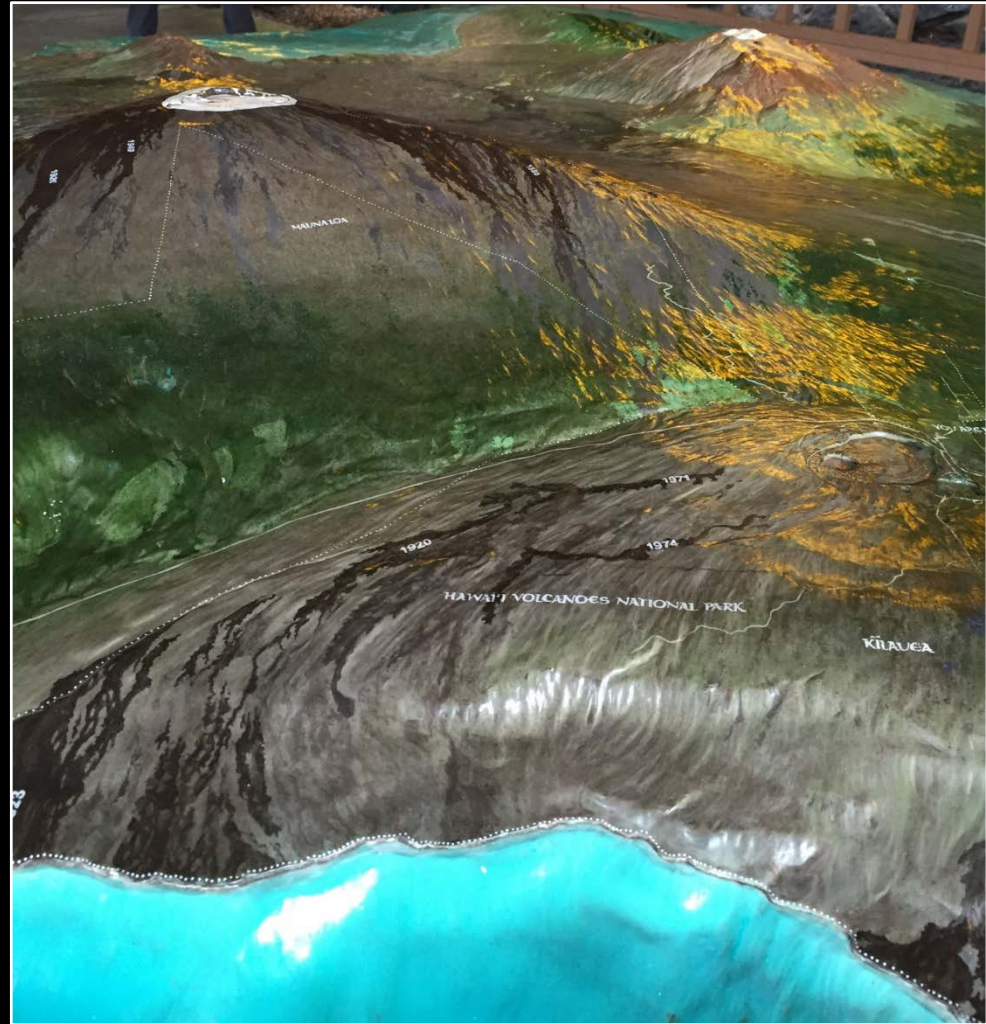
Dec. 1974 Eruption, Kilauea, HI

DECEMBER, 1974 KILAUEA ERUPTION

- December 31, 1974 (night).
 - Duration of ~6 hours.
- Areal Extent: 7.5 km².
- Volume: ~0.0143 km³.
- Mean Eruption Flux: 662 m³/s

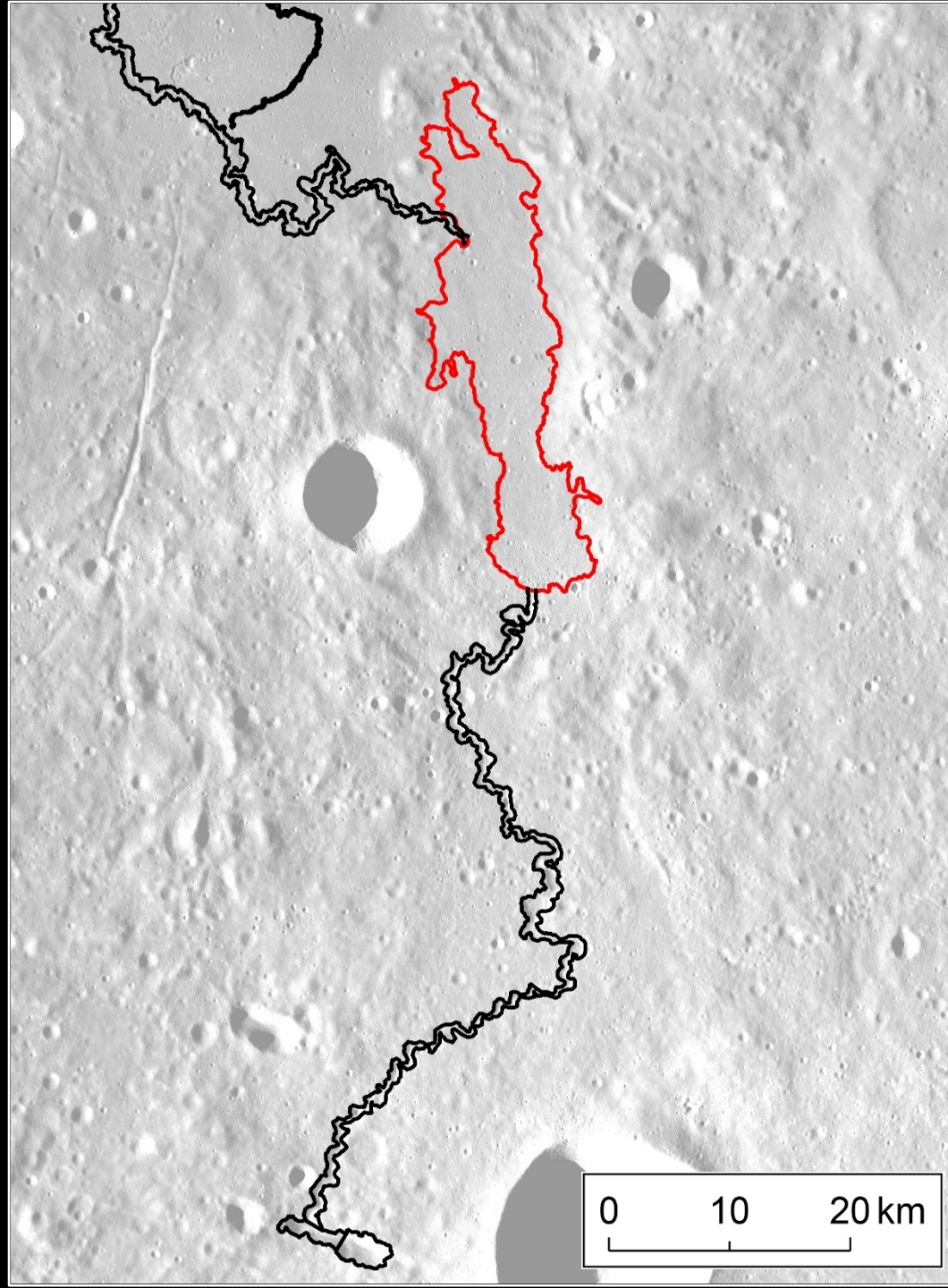


Photos of the July, 1974 eruption, courtesy of the US Geological Survey. No photos of the December, 1974 flow are available.





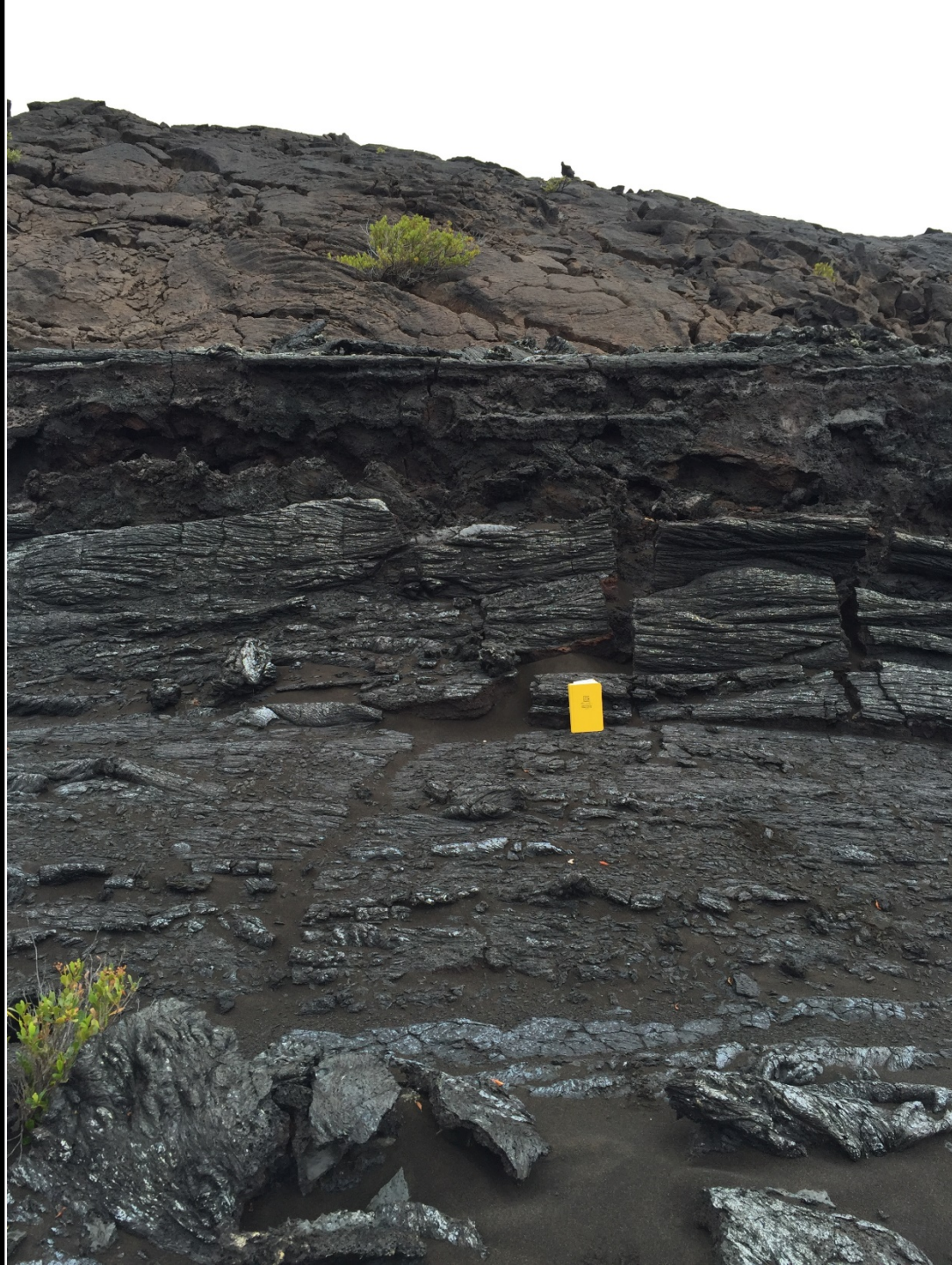
What feature
separates the two
channel
segments?

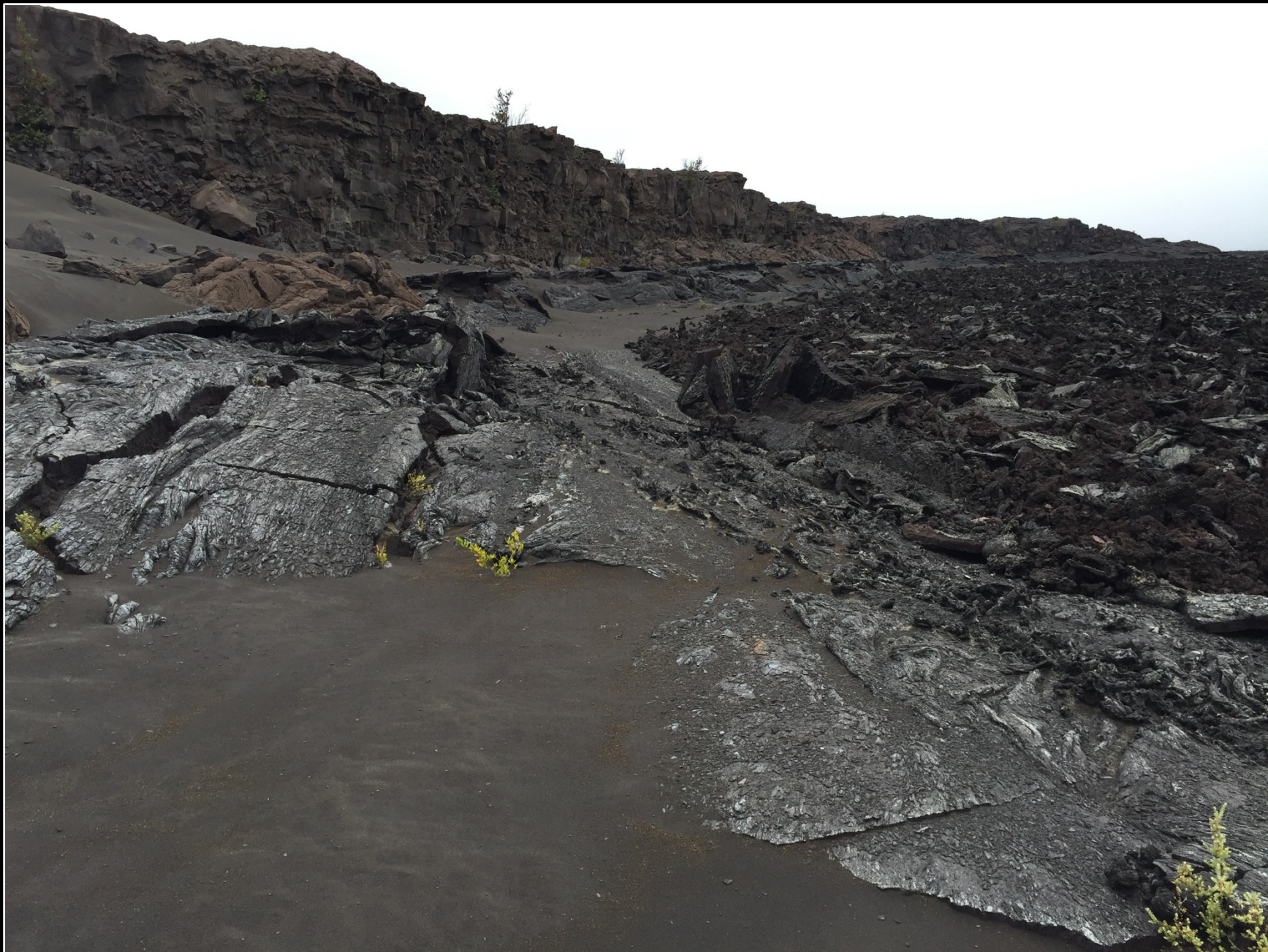


Kaguya TC mosaic









CONCLUSIONS 2: MID-CHANNEL FEATURE

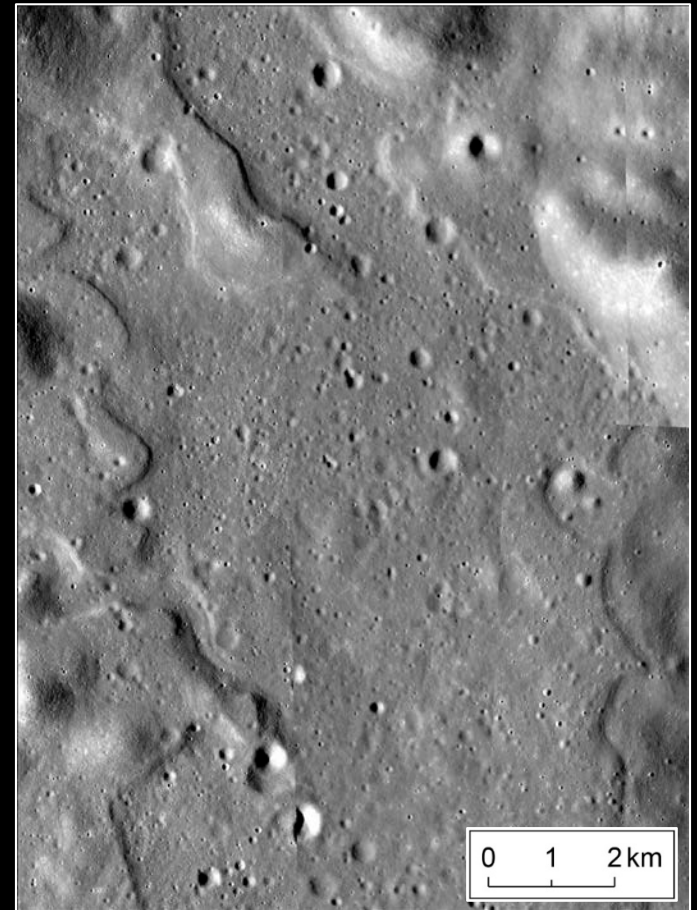
Lava emplaced during the D1974 eruption formed a lava pond.

Marginal ridges represent high lava stands.



Marginal high stands form in the presence of a drained pond of lava.

Lava pond on the Moon!

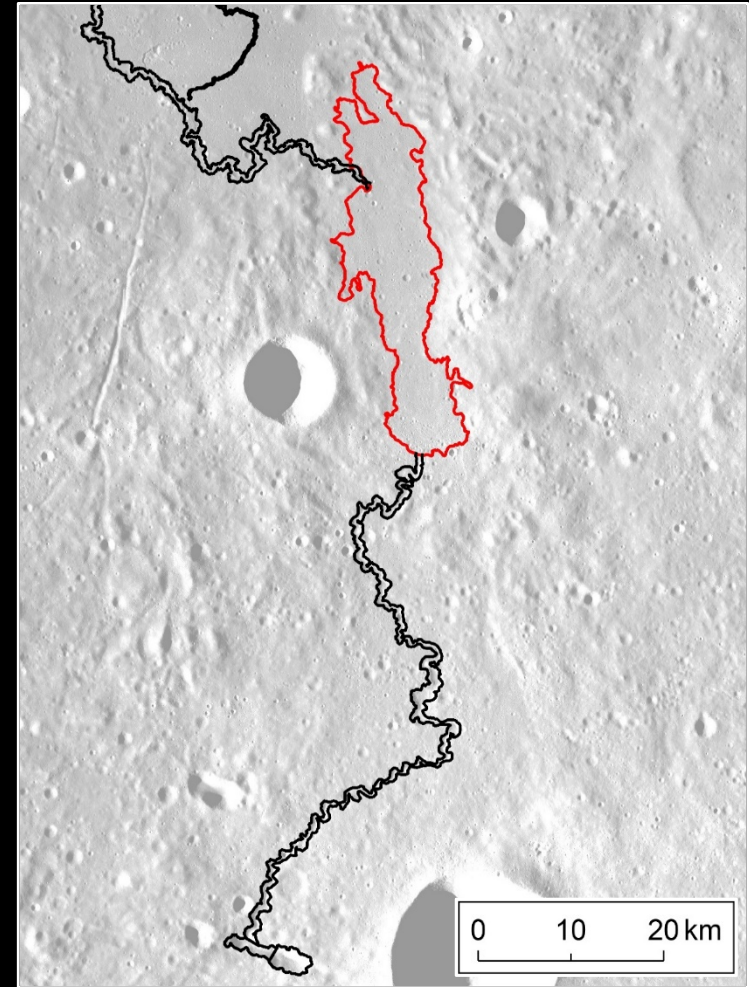


LROC NAC images and
Kaguya TC mosaic

CONCLUSIONS: FORMATION OF RIMA BODE

- Duration of 10 – 22 days at peak eruption rates.
- Length, Width, Depth of Rima Bode:
 - Upper Channel: 109 km; 870 m; 100 m
 - Lower Channel: 139 km; 670 m; 75 m
- Areal Extent of Pond: 266 km².
- Lava Pond Volume: ~14 km³.
- Peak Eruption Flux: 7,000 – 16,000 m³/s

Eruption	Duration	Volume (km ³)	Flux (m ³ /s)
December 1974	6 hours	0.0143	662 (mean)
Holuhraun	183 days	1.6	161 (mean)
Rima Bode	10-22 days	14	7,000-16,000 (peak)





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